

2-Phase Closed-loop Stepper Motor Driver



AiS-D Series PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.

The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Features

- Closed-loop system with real-time position control
- High speed & high torque drive without missing steps
- Easy operation setting with external adjuster (Gain, Speed filter, In-position, Resolution)
- Built-in brake type motors available (AiS-D-B Series)

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

- 01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)**
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 02. Do not use the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**
Failure to follow this instruction may result in explosion or fire.
- 03. Do not connect, repair, or inspect the unit while connected to a power source.**
Failure to follow this instruction may result in fire or electric shock.
- 04. Install the unit after considering counter plan against power failure.**
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 05. Check 'Connections' before wiring.**
Failure to follow this instruction may result in fire.
- 06. Do not disassemble or modify the unit.**
Failure to follow this instruction may result in fire or electric shock.
- 07. Install the driver in the housing or ground it.**
Failure to follow this instruction may result in personal injury, fire or electronic shock.
- 08. Do not touch the unit during or after operation for a while.**
Failure to follow this instruction may result in burn or electric shock due to high temperature of the surface.
- 09. Emergency stop directly when error occurs.**
Failure to follow this instruction may result in personal injury or fire.

⚠ Caution Failure to follow instructions may result in injury or product damage.

- 01. When connecting the power input, use AWG18 (0.75 mm²) cable or over.**
- 02. Brake is non-polar. When connecting the brake, use AWG24 (0.2 mm²) cable or over.**
Failure to follow this instruction may result in fire or malfunction due to contact failure.
- 03. To use the motor safely, do not apply external force to the motor.**
- 04. It is recommended to use STOPPER for the vertical load.**
- 05. Install over-current prevention device (e.g. the current breaker, etc.) to connect the driver with power.**
Failure to follow this instruction may result in fire.
- 06. Check the control input signal before supplying power to the driver.**
Failure to follow this instruction may result in personal injury or product damage by unexpected driver movement.
- 07. Install a safety device to maintain the vertical position after turn off the power of this driver.**
Failure to follow this instruction may result in personal injury or product damage by releasing holding torque of the motor.
- 08. Use the unit within the rated specifications.**
Failure to follow this instruction may result in fire or product damage.
- 09. Use a dry cloth to clean the unit, and do not use water or organic solvent.**
Failure to follow this instruction may result in fire or electric shock.
- 10. The driver may overheat depending on the environment. Install the unit at the well-ventilated environment and forced cooling with a cooling fan.**
Failure to follow this instruction may result in product damage or degradation by heat.
- 11. Keep the product away from metal chip, dust, and wire residue which flow into the unit.**
Failure to follow this instruction may result in fire or product damage.
- 12. Use the designated motor only.**
Failure to follow this instruction may result in fire or product damage.

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Re-supply power after 1 sec from disconnected power.
- Do not input CW, CCW signal at the same time in 2 pulse input method.
- The thickness of cable should be same or thicker than the below specifications when connecting the cable for connector.
 - Power connector: AWG18
 - Motor + Encoder connector: AWG22, AWG24
 - I/O connector: AWG28
- When the signal input voltage is exceeded the rated voltage, connect additional resistance at the outside.
- Use twisted pair (over 0.2 mm²) for the signal cable within 2 m.
- Keep the distance between power cable and signal cable over 10 cm.
- Motor vibration and noise may occur in a specific frequency range.
 - Change the motor installation method or attach the damper.
 - Use the unit out of the corresponding frequency range due to changing motor RUN speed.
- Maintain and inspect regularly the following lists.
 - Unwinding bolts and connection parts for the unit installation and load connection
 - Abnormal sound from ball-bearing of the unit
 - Damage and stress of lead cable of the unit
 - Connection error with motor
 - Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
- This product does not contain a protection function for a motor unit.
- This unit may be used in the following environments.
 - Indoors (in the environment condition rated in 'Specifications')
 - Altitude max. 2,000 m
 - Pollution degree 2
 - Installation category II

Ordering Information

This is only for reference, the actual product does not support all combinations.. For selecting the specified model, follow the Autonics website. Select a model that matches the ordering information of the motor and the driver.

AiS - D - ① ② ③ - ④

① Frame size

Number: Frame size (Unit: mm)

③ Encoder resolution

	□ 20 / 28 / 35 mm	□ 42 / 56 / 60 mm
A	4,000 PPR (1,000 PPR × 4)	10,000 PPR (2,500 PPR × 4)
B	16,000 PPR (4,000 PPR × 4)	-

② Axial length

S: Short
M: Medium
L: Long

④ Motor type

No mark: Standard type
B: Built-in brake type

Product Components

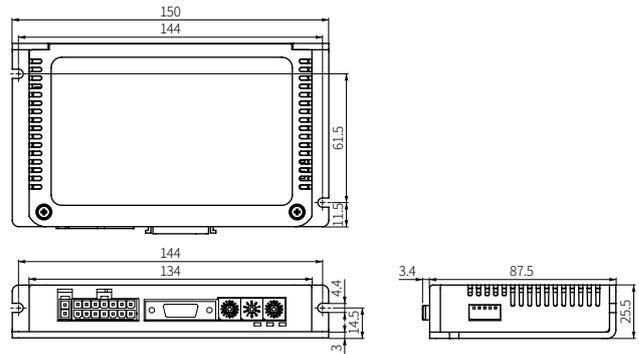
- Product
- Instruction manual
- Power connector
- I/O connector
- Brake connector (AiS-D-B Series)

Sold Separately

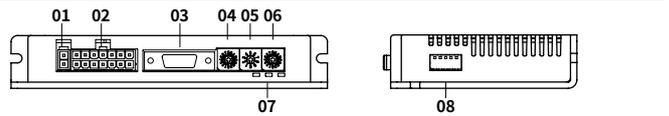
- Power cable: CJ-PW-□
- Motor + Encoder cable: C1D14M-□ (fixed type), C1DF14M-□ (flexible type)
- I/O cable: CO20-MP□-R (specifications: AiS TAG)

Dimensions

- Unit: mm, For the detailed drawings, follow the Autonics website.



Unit Descriptions



01. Power connector

02. Motor + Encoder connector

03. I/O connector

04. Speed filter / Control Gain setting rotary switch

05. Resolution setting rotary switch

06. In-Position setting rotary switch

07. Status indicator

08. Function selection DIP switch

Status Indicators

Indicator	Color	Descriptions
Servo ON / OFF indicator (SERVO)	Orange	Turns ON when servo is ON, Turns OFF when servo is OFF
In-Position indicator (INP.)	Yellow	Turns ON when motor is placed at command position after positioning input
Power / Alarm indicator (PWR/AL)	Green	Turns ON when the unit operates in normal after power is applied Flashes depending on the warning type
	Red	Flashes depending on the alarm type

Alarm / Warning

Depending on the alarm type, it flashes for 0.4 sec interval and it turns OFF for 0.8 sec repeatedly.

■ Alarm

No. of flashing	Alarm type	No. of flashing	Alarm type
1	Overcurrent error	7	Encoder connection error
2	Overspeed error	8	Regenerative voltage error
3	Position tracking error	9	Motor alignment error
4	Overload error	10	Input pulse error
5	Overheat error	11	Input voltage error
6	Motor connection error	12	In-Position error

■ Warning

No. of flashing	Warning type
4	Overload warning

Specifications

Model	AiS-D-20□A	AiS-D-28□B	AiS-D-35□B
Power supply	24VDC≒		
Permissible voltage range	90 to 110% of rated voltage		
Max. RUN power ⁰¹⁾	≤ 50 W	≤ 60 W	
Stop power ⁰²⁾	≤ 10 W		
Max. RUN current ⁰³⁾	0.6 A / Phase	1.0 A / Phase	1.2 A / Phase
Stop current	25% or 50% (factory default: 50%) of max. RUN current		
Resolution	500 (factory default), 1000, 1600, 2000, 3600, 4000, 5000, 6400, 7200, 10000 PPR	500 (factory default), 1000, 1600, 2000, 3600, 5000, 6400, 7200, 10000, 16000 PPR	

Model	AiS-D-42□A-□	AiS-D-56□A-□	AiS-D-60□A-□
Power supply	24VDC≒		
Permissible voltage range	90 to 110% of rated voltage		
Max. RUN power ⁰¹⁾	≤ 60 W	≤ 120 W	≤ 240 W
Stop power ⁰²⁾	S: ≤ 7 W (≤ 16 W) M: ≤ 7.5 W (≤ 16 W) L: ≤ 8 W (≤ 17 W)	S: ≤ 9.5 W (≤ 23 W) M: ≤ 10 W (≤ 23 W) L: ≤ 11 W (≤ 25 W)	S: ≤ 12 W (≤ 25 W) M: ≤ 13 W (≤ 26 W) L: ≤ 14 W (≤ 26 W)
Max. RUN current ⁰³⁾	1.7 A / Phase	3.5 A / Phase	
Stop current	25% or 50% (factory default: 50%) of max. RUN current		
Resolution	500 (factory default), 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000 PPR		

01) When changing the load rapidly, instantaneous peak current may increase. The capacity of power supply should be over 1.5 to 2 times of max. RUN power.

02) Based on ambient temp. 25°C, ambient humi. 55%RH, stop current 50%. The value in the bracket indicates built-in brake type.

03) RUN current varies depending on the input RUN frequency and max. RUN current at the moment varies also.

Run method	2-phase bipolar closed-loop control method
Speed filter	Disable, 2, 4, 6, 8, 10, 20, 40, 60 (factory default), 80, 100, 120, 140, 160, 180, 200 ms
Control Gain	(P Gain, I Gain)=(1, 1), (2, 1), (3, 1), (4, 1), (5, 1), (1, 2), (2, 2), (3, 2), (4, 2), (5, 2), (1, 3), (2, 3), (3, 3), (4, 3), (5, 3)
Max. rotation speed	3000 rpm
In-Position	Fast Response: 0 (factory default) to 7, Accurate Response: 0 to 7
Rotation direction	CW (factory default), CCW
Input	CW/CCW (RUN pulse), Servo ON/OFF, Alarm Reset (Photocoupler input)
Output	In-Position, Alarm Out (Photocoupler output), Encoder Signal (A, Ā, B, B̄, Z, Z̄, Line driver output), Brake (at supplying: 0.2 sec 24VDC≒, normal status: 11.5VDC≒ ± 10%)
Pulse input method	1 pulse, 2 pulse (factory default)
Pulse input voltage	CW, CCW-[H]: 4 - 8VDC≒, [L]: 0 - 0.5VDC≒, Servo ON/OFF, Alarm Reset-[H]: 24VDC≒, [L]: 0 - 0.5VDC≒
Max. input pulse frequency	□ 20 / 28 / 35 mm: CW, CCW: 800 kHz □ 42 / 56 / 60 mm: CW, CCW: 500 kHz
Pulse width	CW, CCW: Input Pulse Frequency Duty 50% (□ 20 mm: ≥ 2 μs, □ 28 / 35 mm: ≥ 1.25 μs) Servo ON/OFF: ≥ 1 ms Alarm Reset: ≥ 20 ms
Rise fall time	CW, CCW: < 0.5 μs

Input resistance	220 Ω (CW, CCW), 10 kΩ (Servo ON/OFF, Alarm Reset)
Insulation resistance	≥ 100 MΩ (500VDC≒ megger)
Dielectric strength	Between the all charging part and the case: 1,000VAC ~ 60 Hz for 1 minute
Vibration	1.5 mm double amplitude at frequency 10 to 55 Hz in each X, Y, Z direction for 2 hours
Shock	300 m/s ² (≈ 30 G) in each X, Y, Z direction for 3 times
Ambient temp.	□ 20 / 28 / 35 mm: 0 to 50°C, storage: -20 to 70°C (no freezing or condensation) □ 42 / 56 / 60 mm: 0 to 50°C, storage: -10 to 60°C (no freezing or condensation) Built-in brake type: 0 to 50°C, storage: -20 to 70°C (no freezing or condensation)
Ambient humi.	35 to 85%RH, storage: 10 to 90%RH (no freezing or condensation)
Protection rating	IP20 (IEC standard)
Certification	CE  
Unit weight (packaged)	≈ 290 g (≈ 400 g)

Troubleshooting

Malfunction	Causes	Troubleshooting
When motor does not excite	Servo is not ON.	Check that servo ON/OFF input signal is OFF. In case of ON, servo is OFF and excitation of motor is released.
	Alarm occurs.	Check the alarm type and remove the cause.
When motor rotates to the opposite direction of the designated direction	Rotation direction setting is incorrect.	Check the DIR setting in the function selection DIP switch.
When motor drives unstable	Connection between motor and encoder is unstable.	Check the driver and motor are connected correctly.
	Control Gain value is not correct.	Change the Control Gain rotary switch.

Connectors

Power connector

Pin	Function
1	24VDC≒
2	GND

Motor + Encoder connector

Pin	Function	Pin	Function
1	GND	8	+5VDC≒
2	Encoder A	9	Encoder Ā
3	Encoder B	10	Encoder B̄
4	Encoder Z	11	Encoder Z̄
5	PE	12	N·C
6	Motor A	13	Motor B
7	Motor Ā	14	Motor B̄

I/O connector

Pin	Function	Pin	Function
1	CW+	11	In-Position+
2	CW-	12	In-Position-
3	CCW+	13	Brake+
4	CCW-	14	Brake-
5	Servo ON/OFF+	15	Encoder A
6	Servo ON/OFF-	16	Encoder Ā
7	Alarm Out+	17	Encoder B
8	Alarm Out-	18	Encoder B̄
9	Alarm Reset+	19	Encoder Z
10	Alarm Reset-	20	Encoder Z̄

Suitable specifications

The following connectors can be used with equivalent or substitute.

Type	Connector Specifications	Manufacture
Power connector	CHD1140-02, connector terminal: CTD1140	HANLIM
Motor + Encoder connector	5557-14R, connector terminal: □ 20 / 28 / 35 mm: 5556T2 □ 42 / 56 / 60 mm: 5556T	Molex
I/O connector	10120-3000PE, housing: 10320-52F0-008	3M

Switch

Speed filter / Control Gain setting rotary switch

Depending on mode selection switch setting, speed filter or position control gain can be set. The setting will be applied when motor stops.

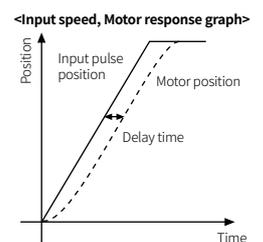
Speed filter

Speed filter sets the operation responsiveness of the motor to input pulse. Set the delay time between the position of input pulse and the position of motor to prevent load changing or disturbance with soft operation function. (If the setting value is too high, the synchronous response by command is decreased.)

Setting	Delay	Setting	Delay
0	Disable	8	60 ms (factory default)
1	2 ms	9	80 ms
2	4 ms	A	100 ms
3	6 ms	B	120 ms
4	8 ms	C	140 ms
5	10 ms	D	160 ms
6	20 ms	E	180 ms
7	40 ms	F	200 ms



S.F./Gain



Control Gain

Control Gain sets the responsiveness of the motor to position command. Gain setting when motor stops, depending on load of motor, realizes rapid positioning and stabilized performance.

-P Gain: Adjust vibration in running drive.
-I Gain: Adjust vibration in accelerating/decelerating drive.

Setting	Control Gain		Setting	Control Gain	
	P	I		P	I
0	1	1	8 (factory default)	3	2
1	2	1	9	4	2
2	3	1	A	5	2
3	4	1	B	1	3
4	5	1	C	2	3
5	6	1	D	3	3
6	1	2	E	4	3
7	2	2	F	5	3



S.F./Gain

Resolution setting rotary switch

The setting will be applied when motor stops.



Res.

Setting	□ 20 / 42 / 56 / 60 mm		□ 28 / 35 mm	
	PPR	Resolution	PPR	Resolution
0 (factory default)	500	2.5	500	2.5
1	1000	5	1000	5
2	1600	8	1600	8
3	2000	10	2000	10
4	3200	16	3600	18
5	3600	18	5000	25
6	5000	25	6400	32
7	6400	32	7200	36
8	7200	36	10000	50
9	10000	50	16000	80

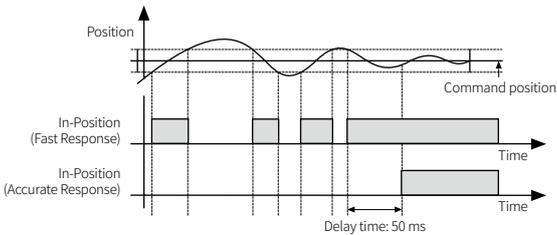
In-Position setting rotary switch

After position command pulse has finished, if the gap between target position and real position is under In-Position setting value, positioning completion pulse is output. The setting will be applied when motor stops.

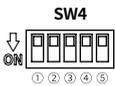


INP.

Fast Response		Accurate Response	
Setting	Value	Setting	Value
0 (factory default)	0	8	0
1	± 1	9	± 1
2	± 2	A	± 2
3	± 3	B	± 3
4	± 4	C	± 4
5	± 5	D	± 5
6	± 6	E	± 6
7	± 7	F	± 7



Function selection DIP switch



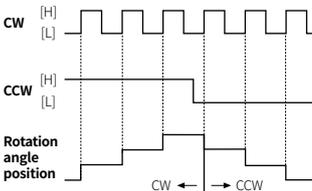
No.	Function	ON	OFF (factory default)	Settings apply
1	Rotation direction	CCW	CW	Immediately
2	Pulse input method	1 pulse input	2 pulse input	
3	Stop current	25% of max. RUN current	50% of max. RUN current	When motor stops
4	SW1 setting	Coltrol Gain	Speed filter	
5	Test mode ⁰¹⁾	Test mode	Normal mode	-

01) This function is for the operation test in manufacturing process. Do not change from OFF status.

Pulse input method

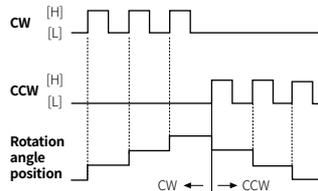
1 Pulse Input method

- CW: Operating rotation signal input
- CCW: Rotation direction signal input
[H]: Forward rotation, [L]: Reverse rotation



2 Pulse Input method

- CW: Forward rotation signal input
- CCW: Reverse rotation signal input

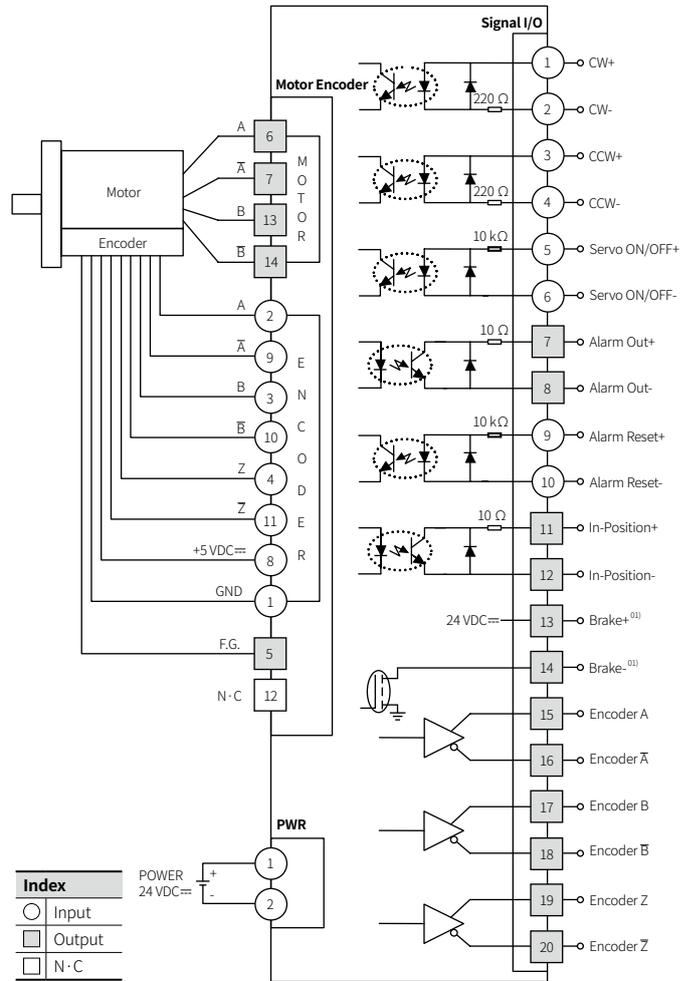


[H]: photocoupler ON (voltage of both ends 4 - 8 VDC \Rightarrow), [L]: photocoupler OFF (voltage of both ends 0 - 0.5 VDC \Rightarrow)

Stop current

In order to decrease motor heat and current consumption at motor stopping moment (in case there is no input during the time of the double width of last input pulse), set the stop current supplied to the motor phase.

Connections



01) The corresponding pin is N · C in standard type.

Control Input

Position command pulse

- Pulse input is selectable from 1-pulse input method and 2-pulse input method.
- When using extending cable, it is recommended to connect Common mode choke coil (2 mH) to the CW, CCW terminal in series connection.

Servo ON/OFF

- This signal is for rotating axis of motor using external force or used for manual positioning.
- [H]: Regarded as Servo OFF signal and phase current is cut to release torque.
The Servo ON indicator, the In-Position output and indicator turns OFF.
- [L]: Regarded as Servo On signal and phase current is supplied to Gain torque.
The Servo ON indicator, the In-Position output and indicator turns ON.
- The signal operates when input more than 1 ms.
- The signal is available when the motor is stopped.

Alarm Reset

- This signal is for resetting the alarm.
- [H]: Alarm is reset, the alarm indicator and alarm output turns OFF, and the driver returns to normal status.
Brake is released.
- The signal operates when input more than 20 ms.
- If the causes of the alarm are not removed, driver may not be returned to the normal status even with alarm reset.

Example of input pulse (CW, CCW) circuit connection

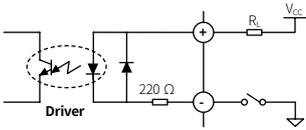
- In case of pulse input, use external power (V_{CC}) 5 VDC=.
- In case V_{CC} is over 5 VDC=, calculate R_L value using following formular and V_{CC} must be under 30 VDC=.

$$R_L = \frac{V_{CC} - 2.17 V}{0.011 A} - 220 \Omega$$

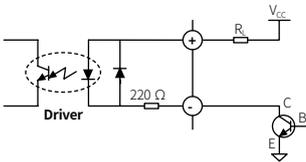
- In case V_{CC} is 12, 24 VDC=, refer R_L value as following table.

V_{CC}	R_L
12 VDC=	680 Ω ($\geq 0.25 W$)
24 VDC=	1.8 k Ω ($\geq 0.5 W$)

Pull-Up circuit

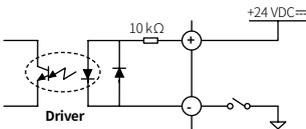


NPN (not-reversed) circuit

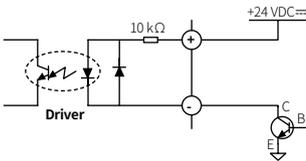


Example of external input (Servo ON/OFF, Alarm Reset) circuit connection

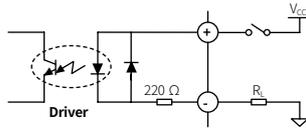
Pull-Up circuit



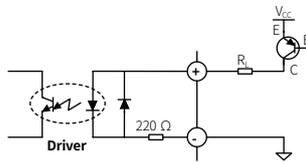
NPN (not-reversed) circuit



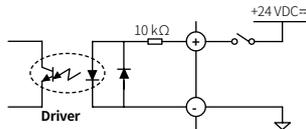
Pull-Down circuit



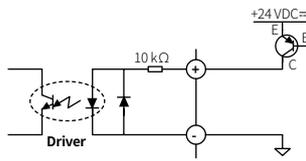
PNP (reversed) circuit



Pull-Down circuit



PNP (reversed) circuit



Control Output

In-Position

- In-Position output is output condition of positioning completion signal.
- If the gap between target position and real position is under In-Position setting value after position command pulse has finished, In-Position output turns to [H] and the In-Position indicator turns ON.
- In reverse, when the gap is over In-Position setting value, In-Position output turns to [L] and the In-Position indicator turns OFF.
- For accurate drive, check the In-Position output again and execute the next drive.

Alarm / Warning

- Depending on the alarm type, it flashes for 0.4 sec interval and it turns OFF for 0.8 sec repeatedly.

<e.g: alarm no. 3>



Alarm

This function stops motor to protect driver, depending on the error status such as overcurrent or overspeed.

In case of normal status, output is [H], and in case of alarming status, output is [L].

When Alarm Reset is applied, driver returns to the normal status.

- When alarm occurs, motor stops, torque remains, Brake locks.

No. of flashing	Alarm type	Descriptions				
1	Overcurrent error	When overcurrent flows at motor RUN element				
2	Overspeed error	When motor speed is over 4,000 rpm				
3	Position tracking error	When the gap between position command value and current position value is over 90°				
4	Overload error	When applying load over the rated load for over 1 sec				
5	Overheat error	When driver inner temperature is over 80°C				
6	Motor connection error	When motor cable connection error occurs at driver				
7	Encoder connection error	When encoder cable connection error occurs at driver				
8	Regenerative voltage error	When regenerative voltage is over 78 V				
9	Motor alignment error	When motor is in misalignment				
10	Input pulse error	When Input pulse is over 3,500rpm				
11	Input voltage error	When input voltage is out of allowable range				
		<table border="1"> <thead> <tr> <th>Frame size</th> <th>□ 20 / 28 / 35 mm</th> <th>□ 42 / 56 / 60 mm</th> </tr> </thead> <tbody> <tr> <td>Allowable range</td> <td>21 - 27 VDC= ±5%</td> <td>24 VDC= ±10%</td> </tr> </tbody> </table>	Frame size	□ 20 / 28 / 35 mm	□ 42 / 56 / 60 mm	Allowable range
Frame size	□ 20 / 28 / 35 mm	□ 42 / 56 / 60 mm				
Allowable range	21 - 27 VDC= ±5%	24 VDC= ±10%				
12	In-Position error	When position error (over 1) is kept over 3 sec, after motor stopped.				

Warning

This function notices dangers with the alarm indicator prior to over load alarm.

When releasing from the warning condition, driver returns to the normal status automatically.

Even though warning occurs, it drives as normal status but it may cause damage by fire.

It is recommend not to use the unit during warning status.

- When warning occurs, motor remains, torque remains, Brake releases.

No. of flashing	Warning type	Descriptions
4	Overload Warning	When maximum load is kept connected over 10 sec. (motor or driver can be overheated)

Example of external output signal circuit connection

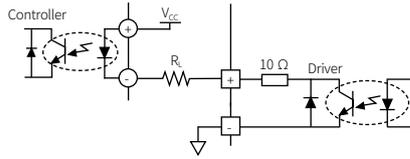
- It is recommended to use V_{CC} below 50 VDC= and use R_L for Ic (secondary detector collector current) of photocoupler inside the driver to be within 25 mA by referring the table as follows.

$$\text{Photocoupler circuit: } R_L = \frac{V_{CC} - 0.3 V - V_F}{0.025 A} - 10 \Omega$$

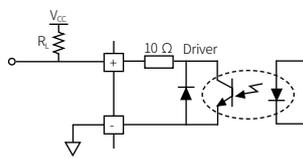
$$\text{Pull-Up, Pull-Down circuit: } R_L = \frac{V_{CC} - 0.3 V}{0.025 A} - 10 \Omega$$

- V_F : LED Forward Voltage of primary photocoupler

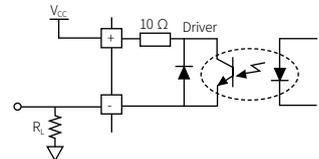
Photocoupler circuit



Pull-Up circuit (reversed)

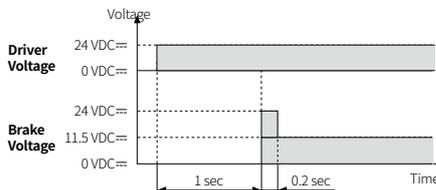


Pull-Down circuit (not-reversed)



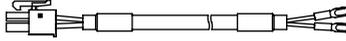
Brake output

- In order to reduce heat in the brake, the driver outputs DC power to remain brake releasing.
- When supplying power to the driver after connecting the driver and brake, the rated excitation voltage is supplied and the brake is released after approx. 1 sec.
Then after approx. 0.2 sec, the excitation voltage is decreased to 11.5 VDC= and the released brake power is maintained.
- While power is applied to the driver, the brake is kept turning on, except in the Servo ON status.



Sold Separately : Power Cable

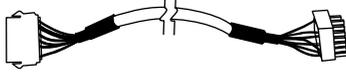
■ CJ-PW-□



- Recommended to use ferrite core at both ends of the cable.
- The model name is 010, 020 which indicates the cable length.
E.g.) CJ-PW-010: 1 m power cable

Sold Separately : Motor + Encoder Cable

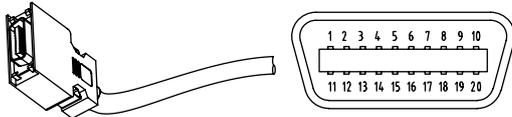
■ Fixed type: C1D14M-□, Flexible type: C1DF14M-□



- Recommended to use ferrite core at both ends of the cable.
- The model name is 1, 2, 3, 5, 7, 10, 15, 20 which indicates the cable length.
E.g.) C1DF14M-10: 10 m flexible type, Motor + Encoder cable

Sold Separately : I/O Cable

■ CO20-MP□-R (specifications: AiS TAG)



Pin	Function (Name TAG)	Cable color	Dot line color-number
1	CW+	Yellow	Black-1
2	CW-		Red-1
3	CCW+		Black-2
4	CCW-		Red-2
5	Servo ON/OFF+		Black-3
6	Servo ON/OFF-		Red-3
7	Alarm Out+		Black-4
8	Alarm Out-		Red-4
9	Alarm Reset+		Black-5
10	Alarm Reset-		Red-5
11	In-Position+	White	Black-1
12	In-Position-		Red-1
13	Brake+		Black-2
14	Brake-		Red-2
15	Encoder A		Black-3
16	Encoder \bar{A}		Red-3
17	Encoder B		Black-4
18	Encoder \bar{B}		Red-4
19	Encoder Z		Black-5
20	Encoder \bar{Z}		Red-5

- Recommended to use ferrite core at both ends of the cable.
- The model name is 010, 020, 030, 050, 070, 100, 150, 200 which indicates the cable length.
E.g.) CO20-MP070-R: 7 m I/O cable